EVR Ecology

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BAT SURVEY UPDATE @ BACK BUILDING, RIDGE FARM, CHAPEL EN LE FRITH, DERBYSHIRE

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1. INTRODUCTION

1.1 BACKGROUND & SITE DESCRIPTION

Dr Elizabeth Barratt was commissioned by Stuart Wilson to update a bat survey at the back building, Ridge Farm, Cowlow Lane, Chapel en le Frith, Derbyshire SK23 9UD. The survey site comprises a two storey stone/brick outbuilding with pitched slate tiled roof. Planning permission is being sought for the conversion of the current building into a new residential dwelling. The OS reference for the site is SK0585 7888. The site plan is included in **Appendix 1**

The original building inspection was carried out on 12th November 2009. The building was inspected for the presence of bats and identification of potential roost sites. The building was re-inspected on the 19th July 2010. An emergence activity survey was carried out on 19th July and 22nd July 2010, and remote monitoring of the interior was undertaken on the 22nd July – 30th July 2010. The site was re-inspected on the 22nd November 2013.

The surrounding habitat is rural upland unimproved and semi-improved grazing pasture delineated by fences and dry stone walls. To the south-east of the barn is the mature gardens attached to Ridge Hall. To the north-west of the site is a copse of mature mixed deciduous woodland. The surrounding buildings, gardens and woodland offer roosting and foraging opportunities for bats.


1.2 PROPOSED WORKS

Planning permission is being sought for the conversion of the back building at Ridge Farm into a residential dwelling..

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1.3 AIMS OF STUDY

The survey was conducted to investigate the status of the site in respect to bat species and barn owls. It was to:

- establish the presence / absence of protected species on the site
- gather species and population information as required for an EPS licence
- inform an assessment of potential impacts on any species found on site and establish whether there may be a requirement for further survey work to achieve this.

1.4 PERSONNEL

Dr Elizabeth Barratt is a mammal ecologist and bat specialist. She is a professional consultant with over 25 years' experience in mammal conservation and survey work, specializing in bat ecology. She has been a licensed bat worker and member of the Cheshire Bat Group since 1986 and is a Voluntary Bat Warden for Natural England, participating in the annual National Bat Monitoring Programme of the Bat Conservation Trust. Dr Barratt is a full member of the Chartered Institute of Ecology and Environmental Management.

2 BAT ECOLOGY

2.1 BATS IN BUILDINGS

Buildings such as houses, barns and outbuildings provide a number of safe dry places for bats to roost. Some bats may remain in one area, others may move around as conditions change. Outbuildings and barns are often used as night roosts and shelters. Potential roost sites in houses and outbuildings are:

walls:

- behind cladding, external tiles or weatherboarding
- inside the cavity wall spaces
- at the top of solid walls

roofs:

- tunnel under the ridge tiles
- between under-felt or boards and tiles or slates
- inside roof space at ridge ends or roof junctions
- inside roof space in gaps between timber and brickwork of chimneys
- under junctions of rafters and hip beams
- at gable end wall
- lower corners of the eaves
- between loft insulation and ceiling

- space between joist and ceiling

eaves:

- between soffit and bargeboard
- behind bargeboards or fascias

There are 6 different types of roost identified (A.M. Hutson 1993). These are:

- spring gatherings (transitional)
- maternity (summer) roosts
- mating roosts
- night and feeding roosts
- prehibernal roosts (transitional)
- hibernation roosts

Summer roosts, found between May and August, are the most obvious. These consist almost exclusively of females, most of which give birth and raise a single young over this period. These colonies usually disperse by the autumn. Some species remain in one roost all year. Some roosts may be transitional, when small numbers are present for a limited period, usually during the spring and autumn. Night roosts are often indicated by large accumulations of insect remains and some droppings.

Most species conceal themselves in crevices and are not easy to find. The presence of droppings is a key sign to their presence. Hibernating bats however leave little or no trace of their presence. Other possible signs are a characteristic odour. Also a clean or polished area at a place through which light can enter may suggest an entrance/exit hole.

The commonest bats, *Pipistrellus* sp and Plecotus *auritus* (brown long-eared), are the most frequently occurring in buildings. The former use crevices, cavity walls, behind tiles and boarding as their roost spots. The latter prefer open roof areas, and their droppings are often concentrated below ridge beams, where they roost, and scattered about the loft area. Other species found in the county are *Nyctalus noctula (*Noctule), *Myotis brandtii* (Brandt's), *Myotis mystacinus* (whiskered), *Myotis nattereri* (Natterer's) and *Myotis daubentonii* (Daubenton's). Of these species whiskered and Natterer's are the most likely to use buildings, but are not commonly found on such sites. It is however likely these species are all under recorded throughout Britain.

2.2 BATS IN LINEAR LANDSCAPES

All UK bats feed on insects that are associated with trees. Their importance varies with species, season and foraging behaviour.

Bats use trees, tree lines and hedgerows and other linear features to navigate at night. Loss or damage to these features affects their ability to commute safely and efficiently between roosts and feeding sites. A gap of as little as 10 metres may force bats to take different routes and even change roosting sites. Linear habitats and features such as tree lines, banks, ditches, watercourses and edges, and hedgerows are important areas for foraging and for shelter against wind or from predators. Loss of connectivity and fragmentation of these features may cause bats to abandon roost sites.

2.3 BARN OWLS

Barn owls are most active just after dusk and just before dawn. In Britain the field vole (*Microtus agrestis*) is the barn owl's main prey species. Shrews and mice are also significant. In the breeding season most foraging occurs within about 1km of the nest. However, during the winter birds have been recorded at up to 4.5 km from their former nest sites. Food supply is the predominant factor governing barn owl survival and breeding success. The ideal habitat for barn owls is rough grassland supporting a high density of small mammals. This can be in the form of linear features such as drainage ditches or woodland edge, or non-linear features such as young tree plantations or fallow pastures. Intensively grazed pasture, silage and arable fields yield little prey and the birds are not adapted to hunt within woodland. Nevertheless, Barn Owl Trust studies have shown that breeding barn owls are sometimes found with less than one acre

of rough grassland within 1km of the nest. Thus even in areas of intensive grazing and cultivation the possible presence of resident barn owls cannot be discounted.

Barn owls are often found in close proximity to humans, making use of farm buildings, dovecotes, church towers, bale stacks and a wide variety of derelict and unused buildings, as well as hollow trees and cliff sites where available. Site use falls into three main categories:

- roosting and breeding,
- roosting only
- visiting occasionally.

Occupied sites are usually free from direct or unusual disturbance. Breeding sites must have a large cavity or wide ledge as barn owls do not build a nest but require a level surface on which to lay eggs. Modern farm buildings are not generally suitable as breeding sites unless nest boxes are provided.

A pair of barn owls will normally use several sites in their home range, for example a breeding site, several roosting sites and other sites that they visit occasionally. However, some pairs seem to use their breeding site as their only roosting place all year round. Once established, adult barn owls show an incredible amount of site fidelity. They usually remain faithful to their sites from one year to the next.

Barn owls have been found breeding in all months of the year, but most eggs are laid in April and May. The eggs are white and are laid at about 2.5 day intervals. The female begins to incubate as soon as the first egg is laid. With a mean clutch size of 5.8, an incubation period of 31 days and an average fledging age of 62.5 days (9 weeks). Fledged young often return to the nest but have normally moved on by their 14th week. Second (and very rarely) even third broods may occur.

3 METHODOLOGY

3.1 FIELD SURVEY

3.1.1 Bats

Building inspection *visit on 12th November 2009, 19th July 2010 and 22nd November 2013*

This was undertaken by Elizabeth Barratt and Pete Giles. This observed the following protocol::

- Checking the exterior of the building for signs of bat entry / exit points; such as staining from urine and oils or excessive scratching.
- Checking the building exterior for droppings, especially on ledges and under the potential access/egress points.
- Checking the interior of the buildings for droppings and feeding remains, any staining on beams, cleared patches of cobwebs and for the bats themselves (both hanging and in crevices).
- Noting all potential access points and roosting opportunities for bats and examining them thoroughly. Any inaccessible points are noted and recorded as a constraint of the survey.

Binoculars and ladders are used as an aid in searching for high access points of entry and exit. All small, accessible crevices were examined with a powerful torch and endoscope for evidence of roosting bats.

Activity surveys

A dusk activity survey was carried out on the 19th and 22nd July 2010

This was undertaken by Elizabeth Barratt and assistant surveyors. The 3 observers were positioned on the north/east, west and south/east sides of the barn complex. This enabled all sides of the barn complex to be observed. All activity was monitored 15 minutes before sunset until 1.75 hours after sunset, using Heterodyne, Time Expansion (EM3+) and Frequency Division (Duet) bat detectors.

Remote Monitoring

Remote monitoring of bat activity throughout the night was undertaken using an anabat automated bat detector set to switch on at dusk and off at dawn. The detector was placed in the roof void over the main body of the church and left in place from the 22nd – 30th July 2010. Further inspections of the roof void were undertaken during placement of the anabat.

3.1.2 **Barn owls**

An inspection visit was undertaken by Elizabeth Barratt on the 12th November 2009, 19th July 2010 and 22nd November 2013

This observed the following protocol:

A search for field signs was undertaken in the building to establish presence of barn owls. Signs of barn owl are stated below. If signs are found the current usage can be established i.e. whether the owls are currently using the building and how they use it, i.e., nest, roost and so forth.

- Droppings – Wherever the owls perch they are likely to deposit their droppings, this appears as white splashes; the quantity and freshness of the whitewash can be evaluated and can help establish the current status of owl usage of a site.
- Pellets – Barn owls swallow their prey whole and later regurgitate the indigestible parts in the form of a pellet. Barn owl pellets are composed mainly of hair and bone. Pellets often accumulate in places where the owl regularly roosts. Barn owl pellets are easily distinguishable from other species therefore they are a reliable source on which to base decisions of type of occupancy and the history of occupancy.
- Feathers - Barn owls undergo their first moult when they are approximately 11 months old, which in most cases is when they are breeding; the most noticeable feathers are the primary feathers which are normally shed between May-October in females and July–November in males. These are very easy to locate during a search and will provide good indicators on the use of the site.
- Nest debris - Barn owls do not build nests like other birds, they use a bed of old pellets in which they scrape out a hollow to lay their eggs in. Typical sites for nests in buildings will be on top of walls, normally over 3m above the ground. The sites are very noticeable with an accumulation of pellets, food remains, and whitewash.

If any of the above signs are found during the initial survey, the age, quantity, site location, and local habitat will be evaluated and a judgment of building usage will be made. If barn owls are found to be present, a follow up visit at night will be undertaken to confirm the presence and to establish the extent of usage of local habitat.

3.1.3 Nesting Birds

An inspection of the buildings and site, undertaken by Elizabeth Barratt and Pete Giles on the 8th August 2013, also looked for evidence of presence of breeding bird activity: for example, the construction of nests by wild bird species and evidence of their presence and use of the site. Evidence includes bird droppings, feathers, eggs and egg remains, bird skeletons and nesting materials.

4. RESULTS

4.1 FIELD SURVEY

4.1.1 *Building Inspection survey on 12th November 2009*

An external and internal examination of the building was carried out. This is subject to the constraints listed in Section 5.1.

- The back building was found to have deteriorating state.
- Movement in the stonework of the walls has led to cracks in the lower floor
- Ridge and pitch tiles have slipped and are missing.
- Access to upper floor via eaves
- Open access to both floors is via pitch holes and doorways
- No felting is present. Slate tiles sit directly on the roof timbers
- All potential gaps in brick work were examined using an endoscope. No evidence of bat activity was found associated with these gaps
- The tops of the walls were inspected, no potential roosting sites were identified
- The main frame joists were examined, no potential roosting sites were identified

- Five scattered droppings were found on the floor of the upper level ~ no clusters of droppings were found and no bats were present at the time of survey. This would be consistent with bats flying round the internal space to investigate the site.

The building was re-inspected on **19th and 22nd July 2010**. No fresh droppings were found during these surveys. All gaps were examined internally using the endoscope. No evidence of roosting bats was found during this survey

The building was re-inspected on **22nd November 2013** all doors and windows were open as the building has continued to deteriorated. The staircase is no longer present having been removed for health and safety reasons. The internal temperatures are therefore lower than on previous visits and the upper floor is lighter due to the absence of the door. All accessible potential roost/hibernation sites were inspected using a torch and endoscope as required. No evidence of hibernating bats was found at the time of survey. All gaps were examined internally using the endoscope. No evidence of roosting bats was found during this survey. Three scattered droppings were found on the floor of the upper level ~ no clusters of droppings were found and no bats were present at the time of survey. This would be consistent with bats flying round the internal space to investigate the site.

Emergence survey 19th and 22nd July 2010
The initial activity survey on the 19th July was abandoned after 60 minutes due to continual heavy rain. No bats were recorded emerging from the back building during this survey.

The survey was on the 22nd July 2010
Results, timing and conditions are detailed in **Table 1 & 2** in **Appendix 2**.
The location of bat activity recorded is given in the site diagram in **Appendix 1**

Two species of bat were recorded commuting across the site and foraging around the tree/hedgerow to the western edge of the site. Common pipistrelle (*Pipistrelle pipistrellus*), and a single BLE contact (*Plecotus auritus*). Bats arrived on site from the south and south west. Bats were recorded on site 28 minutes after sunset. No bats were observed emerging from the back building or

Remote Monitoring 22nd -30th July 2010
Two species of bat were recorded by the anabat placed in the upper level of the back building: Common pipistrelle and brown long-eared bats. Activity was recorded on two nights of the seven nights recording. The predominant species was the Common pipistrelle. Foraging and commuting calls were recorded and activity was observed approx. 55 minutes after sunset to midnight then the activity tailed off. Recordings from anabat detectors do not allow distinction between bats inside the back building and those flying over the roof top. No activity was recorded at dusk and pre-dawn as would be expected if this was a roost site.

4.1.2 Barn Owls
No evidence of barn owl activity was found during any of the building inspections.

4.1.3 Nesting Birds
Evidence of roosting/nesting bird activity was found on the upper floor of the back building. At the time of survey the nests were no longer occupied.

5 ASSESSMENT

5.1 CONSTRAINTS OF SURVEY
5.1.1 Surveying for bats at a specific season of the year does not provide information of use of the site by bats at other times of the year. Whilst consideration may be given to roosting at other times, there may be no evidence for this outside the survey period.

5.1.2 No active bats may be present or detectable at time of survey.

5.1.3 Small roosts and single roosting bats can easily be overlooked. They can be difficult to detect during inspection as they leave few field signs.

5.1.4 In winter and during cold spells bats, when temperatures drop below 9 or 10 degrees, the bats become less active. If torpid and/or hibernating, they may squeeze deep into cracks and crevices in brickwork, brickwork and woodwork. They can be difficult to spot even with the help of an endoscope.

5.2 CONCLUSIONS

5.2.1 Bats

It is concluded on the evidence from these surveys, under the constraints given in 5.1, that the back building does not support a roosting bat population at this time, though there is a local bat population present in the vicinity and foraging over the site.

- The back building is rapidly deteriorating in condition
- The conditions in the building have changed and light levels have increased in the upper level of the back building.
- No evidence of roosting bat activity was found during the surveys although bats were found to be flying round the building.
- Surrounding properties provide optimal roosting opportunities for the bat species identified in the activity survey found in this area; pipistrelle (common) and brown-long eared bats
- The surrounding area provides good foraging habitat and commuting routes in an upland setting

5.2.2 Barn owls

There is no evidence of barn owl activity on site at the time of survey.

5.2.3 Nesting Birds

Birds have nested in the back building over the summer.

5.3 POTENTIAL IMPACTS

5.3.1 Bats

It is assessed that on present evidence the proposed re-development of the back building will not have any long-term impact on the local bat population and will not adversely impact on

- The ability of any significant group of bats to surveys, breed or rear young
- The local distribution or abundance of the species of bats present in the vicinity

5.3.2. Barn Owls

There is no evidence of barn owl activity and therefore no potential impacts by the proposed re-development of the buildings.

5.3.3 Nesting birds

There is potentially an impact on nesting birds through:

- disturbance on site during the breeding season due to building works
- loss of nesting areas in barns and outbuildings due to demolition and/or development.

5.4 LEGISLATION AND POLICY GUIDANCE

Full details of the legislation for protected species are given in **Appendix 3**.

6 RECOMMENDATIONS AND MITIGATION

6.1 FURTHER SURVEY

6.1.1 **Bats**

No further surveys are required at this point. It should be noted that bats are highly mobile creatures, are present in the vicinity and may relocate to new sites during the active season April-October. All care must therefore be taken to avoid entrapping bats during reconstruction works and best practice guidance must be followed

6.1.2 **Barn Owls**

No further surveys are required at this time.

6.1.3 These conclusions and recommendations in this report in respect to surveys for protected species are based upon results from surveys in 2009 - 2013. These data will only be of use for the following active season after which further survey to establish the position and possible changes in status will be necessary to ensure all activities are informed and guided by recent data on site status.

6.2 REQUIREMENTS FOR EPS LICENSING

Based on the survey results from 2012/2013 there is no requirement at this time to apply for a licence from Natural England Wildlife Licensing Unit for the works to proceed. **In the event that bats are found during in any refurbishing that is being undertaken then all work must stop, workers withdraw from the site and a licensed bat worker or Natural England contacted for advice and to review the licensing position.**

Failure to stop work and take advice in the event of finding bats may result in a breach of the law under the Wildlife and Countryside Act 1981 (as amended) under Section 9(4)(a), which states that it is an offence to 'intentionally or recklessly damage, destroy or obstruct access to any structure or place used for shelter or protection by a bat'. Conversion could also lead to an infringement under the Conservation (Natural Habitats & c) Regulations, which states it as an offence to 'deliberately damage or destroy a breeding site or resting place of a bat' [Regulation 41(1)(d)].

Failure to stop work and take advice in the event of finding a protected species may result in a breach of the law under wildlife legislation (Appendix 3).

6.3 BEST PRACTICE APPROACH

6.3.1 **Bats**

Although bats are not roosting in the buildings at this time, the surrounding area has a resident bat population therefore the best practice guidance given below should be followed.

When carryout a redevelopment, developers should be aware that if bats or signs of bats are found during works, all work should cease and Natural England or a licensed bat consultant contacted immediately and their advice followed. Failure to do so may result in an offence under the legislation in relation to bats as detailed in Section 5.1 of this report. On no account should the bat(s) be handled by anyone other than a licensed bat worker.

Timing of works

Bats are highly mobile and colonise different places throughout the year. Bats are generally less or not active around buildings during the period of September to April, depending on weather conditions.

Timing work to begin in the period September to November or late February to early April (depending upon the weather conditions) will reduce the potential for disturbance to bats and the risk of injury to undetected bats within a building. Roof stripping should be undertaken and completed as far as possible within this window. **Any work on roof stripping of sensitive areas such as ridges, wall tops, eaves and gable ends undertaken outside this timeframe can only be done following an activity survey.**

1. Demolition/deconstruction and other building works

- Roof stripping will be done using a soft protocol method which involves the removal of roof coverings using both hands to lift each slate clear thus avoiding rolling them, which might squash any roosting bats that may be present but undetected. In the case of metal /asbestos sheeting all sheets are removed by lifting off, not sliding down the roof pitch. Bats are often found between the upper surfaces of internal divisions and the roof cover and can be crushed if care is not taken. Areas where the roof is intact, particularly over the internal walls, purlins, eaves and remaining ridge tiles, will be very carefully removed as these have the most potential for bats to use
- Once the roof is fully removed then the structure will be left open for 2-3 days when weather conditions are above 8 degrees to allow any undetected bats present to move off
- Deconstruction of any internal double-skin walls that have identified cavities will be done by hand with care and materials examined on removal for bats and signs of bats. This will account for a small possibility of bats being present and undetected.

2. Reconstruction/new building

- If new build/reconstruction is being undertaken during the active season for bats between April and November, it may offer new roosting opportunities for bats that are active on site. It is therefore preferable to complete roofing **and** all external work to seal the building prior to starting the installation of internal fixings. If this is not possible then any cavities created by installation of plaster-boarding and so forth are covered at night to prevent entry and potential of entombing bats in the works.
- Once external apertures are fitted all will be kept closed overnight
- Any replacement/insertion of windows and other fills to apertures that are required should be done by completing the removal and replacement in a day to prevent any crevices being left open overnight. All reveals should be sealed (temporarily if necessary) overnight to avoid bats entering into exposed crevices in walls.
- Further advice on measures to prevent entrapment of bats and methods of preventing entry can be provided on request by a qualified consultant bat specialist.

If bats or signs of bats are found at any time when any demolition, deconstruction, renovation or alteration work is being undertaken then work should stop and advice sought from a qualified bat specialist or representative of Natural England. On no account should bat(s) be handled by anyone other than a licensed bat worker. Failure to do so will result in an offence being committed under the legislation as detailed in Appendix 3.

6.3.2 **Nesting birds**

Nests of wild birds are protected and work must not be carried out if nesting birds are present in the barn to be refurbished. Start of work on the building should be set to begin outside the breeding season for birds, which is March to September, although this may be dependent on weather conditions. Cold weather may delay the onset of nest-building or warm weather may bring it forward. Removal of roof areas between October and March will be suitable timing for bats and for birds.

During works, which are likely to extend into the breeding season, a watching brief will be maintained to ensure that no nesting birds are disturbed. It is best to ensure exclusion from work areas prior to the breeding season to prevent nesting activity. Day time activity during ongoing development work will help to discourage birds from using the site. If birds of any wild species are found to be nesting or nest-building in the buildings then work must be delayed until the young have fledged. This may require a delay in that area until the end of season in September. No work may be carried out within 10m of an active nest.

Artificial nest sites can be put up in suitable positions around the site boundary. Birds are declining due to loss of roost and nesting places. The erection of artificial nests at selected points on the property prior to the birds' exclusion from the barn and house will provide alternative sites and make a positive contribution to their conservation. Swallows prefer building nests between rafters and some form of canopy, which can be provided by an area of an outhouse or an open barn with a suitable roof structure. Other birds prefer a ledge or gap in brickwork to build. These features can be incorporated into an outhouse/garage and artificial nests can be put up to encourage occupation of the new area.

6.3.4 **Conservation and enhancement of site**

It is also recommended:

- Where possible, the mature trees and hedgerows on, around and near the site should be retained. These have potential to develop into natural roosting sites for bats and nesting sites for birds.
- **Removal of any large mature trees should only be done following an inspection for potential roost holes for bats.**
- The bat species recorded in the activity survey are crevice dwellers. **Crevice Roost Sites** can be created through the incorporation of bat boxes into the re-developed barn or onto the mature trees within the boundary and a list of suitable boxes is given in the **Appendix 4**
- Any additional lighting around the site should be designed to point downwards and away from any potential roosting sites such as the trees. No lighting will be installed or directed towards the positions of the bat boxes. **Appendix 5** provides advice from the Bat Conservation Trust on lighting protocols.
- It is also recommended that insect attracting shrubs be incorporated into any future planting scheme to encourage the presence of insects and thereby provide suitable foraging sites for wildlife, and particularly bats, which have been observed to use the site for foraging (see **Appendix 6**).

7 REFERENCES

BCT (2012) *Bat Surveys Good Practice Guidelines* Bat Conservation Trust

English Nature (2004) *Bat Mitigation Guidelines* Version January 2004

JNCC (2004) *Bat Workers Manual* Third Edition

JNCC (2001) *Habitat management for bats*

8 APPENDICES

Appendix 1: Site sketch for Back Building, Ridge Farm, Chapel en le Frith

Appendix 2: Activity survey results for Back Building, Ridge Farm, Chapel en le Frith

Appendix 3: Legislation and policy guidance

Appendix 4: BCT bat box guidance

Appendix 5: Lighting for bats (BTC guidance notes)

Appendix 6: Landscaping for bats

Appendix 2: Results tables for activity survey at Back Building, Ridge Farm on 22nd July 2010

Key:
- Pip *sp* = pipistrelle species
- Pip 45 = Common pipistrelle (*Pipistrellus pipistrellus*)
- Pip 55 = soprano pipistrelle (*Pipstrellus pygmaeus*)
- BLE = brown long-eared (*Plecotus auritus*)
- Myotis = one of Myotis genera of bats
- Noctule = noctule bat (*Nyctalus noctula*)
- HNS = heard not seen
- EL = echolocation
- FB = feeding buzz
- SC = social calls

Bold type indicates emergence/entry by bat(s)
Bold italic indicates potential emergence/entry by bat(s)

Table 1: Timing and conditions for emergence survey on 22nd July 2013

	Time	Temperature	Wind	Cloud cover	Precipitation
Start	21.00	16.5^{0}C	breezy	100%	Light rain shower at 22.25
End	23.00	13.5^{0}C		100%	
Sunset	21.21				

Table 2: Emergence survey on 22nd July 2010

Observer 1 ~ south entrance of back building		
time	**species**	**activity**
21.49	*Pip spp.*	CP S to N from buildings/garden to S
21.55	*Common pipistrelle*	CP S to N from buildings/garden to S
22.03	*Common pipistrelle*	CP S to N from buildings/garden to S
22.04	*Common pipistrelle*	CP SW to NE
22.27	*Common pipistrelle*	CP SW to NE
22.37	*BLE?*	Brief contact, poss. BLE
22.41	*Common pipistrelle*	CP SW to NE over building to south west of back building

Observer 2 ~ garden		
time	**species**	**activity**
21.52 – 22.12	*Common pipistrelle*	F to N corner of garden near tree copse
22.27 – 22.49	*Common pipistrelle*	F to N corner of garden near tree copse
22.53	*Common pipistrelle*	F in courtyard

Appendix 3: Legislation and Policy Guidance

BATS

Bats are offered special protection under the following legislation:

- **The Wildlife and Countryside Act 1981 (as amended) Schedule 5, Section 9**. This Act transposes into UK law the **Convention on the Conservation of European Wildlife and Natural Habitats** (commonly referred to as the "Bern Convention". The WCA was recently amended by the **Countryside and Rights of Way [CroW] Act 2000.** This makes it is an offence to:
  - intentionally kill, injure or take any species of bat [Section 9(1)]
  - possess or control any live or dead specimens or anything derived from a bat [Section 9(2)]
  - intentionally or recklessly damage, destroy or obstruct access to any structure or place used for shelter or protection by a bat [Section 9(4)(a)]
  - intentionally or recklessly disturb a bat while it is occupying a place or structure which it uses for that purpose [Section 9(4)(b)].

- **"The Conservation of Habitats and Species Regulations 2010 (as amended)"** (The Habitats Directive) transposes into UK law **Council Directive 92/43/EEC** of 21st May 1992 on the **Conservation of Natural Habitats of Wild Fauna and Flora (**2010 revised**)**(referred to as the Habitats [and Species] Directive). Bats are listed on Annex II and Annex IV of the Directive. Inclusion in Annex II serves to underline their (the bats') conservation significance; inclusion in Annex IV (European Protected Species) means that member states are required to put into place a system of strict protection as outlined in Article 12. This is done through inclusion in Schedule 2 (Annex IV) of the Regulations. Regulation 41 makes it an offence to:
  - deliberately capture or kill a bat [Regulation 41 (1)(a)]
  - deliberately disturb a bat [Regulation 41(1)(b)]
  - deliberately damage or destroy a breeding site or resting place of a bat [Regulation 41(1)(d)].

BARN OWLS

Barn owls, *Tyto alba*, are protected under the **Wildlife and Countryside Act 1981**, in which they are classified as a schedule one species, under this special protection it is an offence to:

- Kill, injure, or take (handle) any wild barn owl.
- Take, damage or destroy any wild barn owl nest whilst in use or being built (Barn owls do not build a nest but make a scrape).
- Take or destroy a wild barn owl egg.
- Have in one's possession a wild barn owl (dead or alive), or egg, unless one can show it was obtained legally.
- Disturb any wild barn owl whilst "building" a nest or whilst in or near a nest containing eggs or young.
- Disturb any dependant young of wild barn owls.

NESTING BIRDS

Wildlife legislation through the *Wildlife & Countryside Act 1981* states it is an offence to

- Intentionally kill, injure or take any wild bird
- Intentionally take, damage or destroy the nest of any wild bird while that nest is in use or being built
- Intentionally take or destroy an egg of any wild bird

The *Wildlife & Countryside Act 1981* has several subsequent amendments the most important being the *Countryside and Rights of Way Act 2000* (CROW) which under Schedule 12 of the Act strengthens the legal protection for threatened species. It also makes certain offences 'arrestable' and importantly and significantly creates a new offence of **reckless disturbance**. It also confers greater powers to police and wildlife inspectors for entering premises and

obtaining wildlife tissue samples for DNA analysis, and also enables heavier penalties on conviction of wildlife offences.

Schedule 12 amendment state: '...In section 1(5) of the 1981 Act (offence of intentional disturbance of wild birds) after "intentionally" there is inserted "or recklessly".

BADGERS

Badgers are protected under the Badger Acts 1973 (protection from unlawful killing) and 1991 (setts). These were consolidated in UK law in the Protection of Badgers Act 1992 which makes it illegal to:

- kill, injure or take a badger
- cruelly ill-treat any badger
- interfere with a badger sett

Further policy guidance is available if required.

EXCEPTIONS FOR LICENSING

There are several exceptions to the provisions listed above under Regulation 44(2)(e). The Wildlife Licensing Unit of Natural England issues licences for a number of purposes, including "*preserving public health or safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment.* Licences permit unlawful activities under and in accordance with the terms of a licence granted by the appropriate authority.

Regulations 41 does not apply to anything done (under appropriate licence) for any of the following purposes

- scientific or educational purposes;
- ringing or marking, or examining any ring or mark on, wild animals;
- conserving wild animals or wild plants or introducing them to particular areas;
- protecting any zoological or botanical collection;
- preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment;
- preventing the spread of disease; or
- preventing serious damage to livestock, foodstuffs for livestock, crops, vegetables, fruit, growing timber or any other form of property or to fisheries.

The appropriate authority shall not grant a licence under this regulation unless they are satisfied-

(a) that there is no satisfactory alternative, and

(b) that the action authorised will not be detrimental to the maintenance of the population of the species concerned at a favourable conservation status in their natural range.

Appendix 6: Landscaping and the conservation of bat populations

Planting to enhance a site for bats should aim to provide a habitat rich in insects, and with the potential for alternative roosting sites. The construction of shelter belts, especially around a pond will create areas with high densities of insects.

1 TREES AND SHRUBS

Oak	*Quercus robur*
Ash	*Fraxinus excelsior*
Silver Birch	*Betula pendula*
Field Maple	*Acer campestre*
Hawthorn	*Crataegus monogyna*
Alder	*Alnus glutinosa*
Goat Willow	*Salix caprea*
Guelder Rose	*Viburnum opulus*
Hazel	*Coryllus avellana*
Blackthorn	*Prunus spinosa*
Elder	*Sambucus nigra*
Butterfly-bush	*Buddleja davidii*

2 NIGHT-SCENTED FLOWERS

As bats usually feed at dusk and dawn it is advantageous to use night-scented flowers which will attract moths and other night-flying insects.

Nottingham Catchfly	*Silene nutans*
Night -flowering Catchfly	*S. noctiflora*
Bladder Campion	*S. vulgaris*
Night-scented Stock	*Matthiola bicornis*
Dame's-violet	*Hesperis matronalis*
Common Evening-primrose	*Oenothera biennis*
Soapwort	*Saponaria officinalis*
Tobacco plant	*Nicotiana affinis*
Cherry pie	*Heliotopum x hybridum*

3 SCENTED HERBS

Chives	*Allium schoenoprasum*
Sage	*Salvia officinalis*
Marjoram	*Origanum vulgare*
Borage	*Borago officinalus*
Mint	*Mentha* sp.

4 CLIMBERS

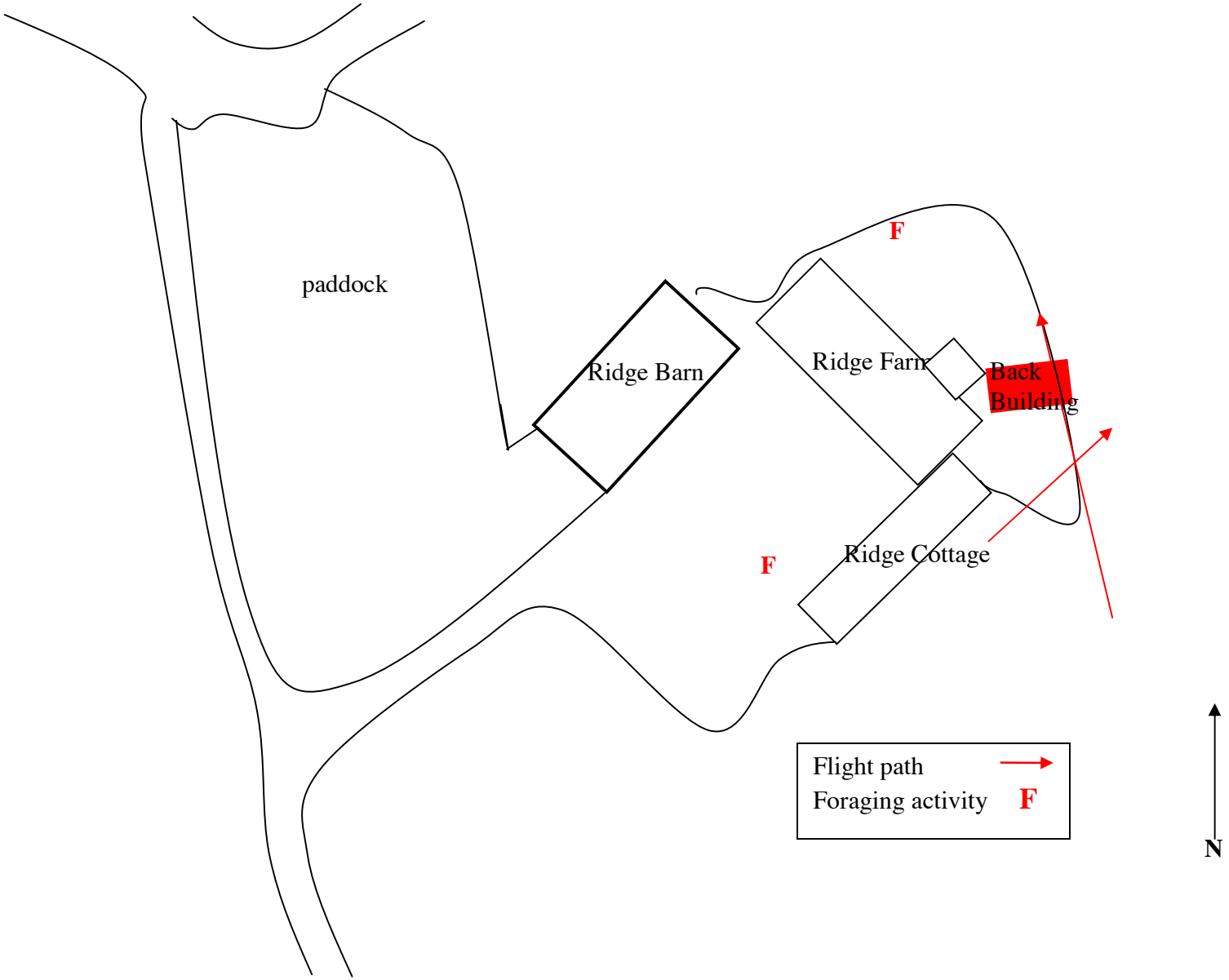
Perfoliate Honeysuckle	*Lonicera caprifolium*
Italian Honeysuckle (garden)	*L. etrusca*
Japanese Honeysuckle	*L. japonica*
Honeysuckle (native)	*L. periclymenum*
White jasmine	*Jasminium officinale*
Dog-rose	*Rosa canina*
Sweet-briar	*R. rubiginosa*
Field-rose	*R. arvensis*
Ivy	*Hedera helix*
Bramble	Rubus fruticisos agg.

Leaving areas of grass uncut allows larval stages of these insects to develop.

Source:

Bats in the garden by Shirley Thompson, 1989. School Garden Company. Spalding Lincs
Bat Conservation Trust leaflet 'Garden for Bats'

Appendix 1: Site plan for Ridge Barn; Back building



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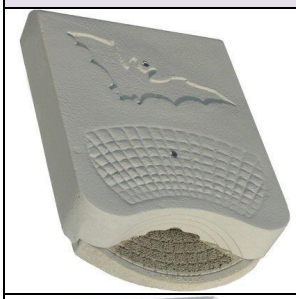
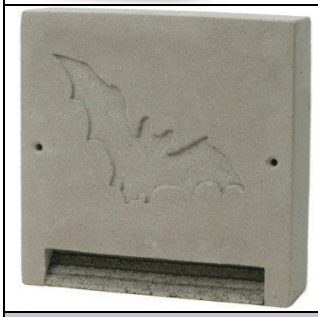
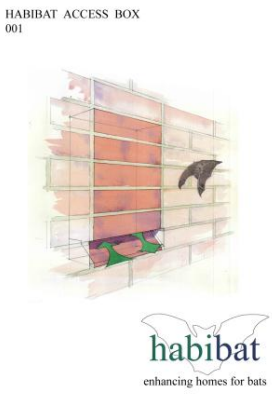
Below is a list of bat related products that may be used for bat enhancement. However, please be aware that BCT does not endorse any particular product or brand as very little evidence is available to demonstrate that they are successful.

Bat Boxes	**In situ**	**Description**	**Company**	**Estimated price**
For external surfaces of buildings:				
		**Schwegler 1 WQ Summer & Winter Roost** Dimensions: 580 H x 380 W x 120 D Weight: 22Kgs	Alana Ecology Jacobi Jayne The Code Store	£90 to £139
		**Schwegler 1 FQ Bat Roost** Dimensions: 600H x 350W x 90D mm Weight: 15.8 Kgs	Alana Ecology Jacobi Jayne NHBS The Code Store	£70 to £90
	Internal or external 	**1 Schwegler FE Bat Access Panel** with optional back plate External Dimensions: H 30 x W 30 x D 8 cm Weight: 7.8 kg	Alana Ecology Jacobi Jayne NHBS The Code Store	£38 to £49
To integrate into walls:				
	Can be built with timber, brick or stone facing to match walls. *BCT is using the Habibat as a research and monitoring tool.	**Habibat** Dimensions: 215 x 215 mm Or 215 x 290 mm	Habibat NHBS	£82.50 to £129

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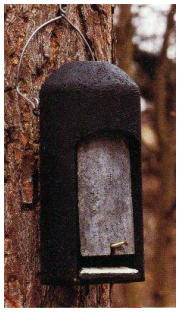
		**Schwegler 1FR Bat Tube** Dimensions: H 475 x W 200 x D 125 mm Entrance W 150 x D 20mm Weight: 9.5kg	Alana Ecology Jacobi Jayne NHBS	£72 to £75
		**Schwegler 2FR Bat Tube** The 2FR bat box is based on the same design as the 1FR, but with the addition of holes in the sides. This allows multiple tubes to be placed next to each other to form a much larger bat roost.	Alana Ecology Jacobi Jayne NHBS	£72 to £76
		**Ibstock enclosed bat box**	Ibstock	
For trees:				
	Trees or flat surfaces	**Schwegler 1FF Bat Box** Dimensions: 430H x 270W x 140D mm. Entrance hole: 120 x 240mm	Alana Ecology Jacobi Jayne NHBS	£56 to £60
	Trees	**Schwegler 2F Bat Box** (General Purpose) Woodcrete 33cm H x diameter 16cm Note: location of access hole means that box is not self-cleaning.	Alana Ecology NHBS	£27.95

	Trees	**Schwegler 2FN Bat Box** The 2FN Bat Box has two entrances - one at the front and one at the rear against the tree. It has a domed roof to form clusters and an increased internal height. 36cm H x diameter 16cm 4.3kg	NHBS Nature Counters	£34.95
	Trees	**Schwegler 1FD Bat Box** The 1FD is a large general purpose bat box. Effectively it is a larger version of the Schwegler 2F bat box, with the addition of two roughened wood panels inside the box which simulate crevices. Note: location of access hole means that box is not self-cleaning.	Alana Ecology NHBS	£49 to £55
Wooden bat boxes				
	Fitted to walls, other flat surfaces or trees	**Kent Bat Box** Materials to be made from untreated rough-sawn timbers. Timber should be 20mm thick. The box should be rainproof and draught-free. Crevices can be between 15 & 25mm wide	Self constructed. Instructions from BCT.	

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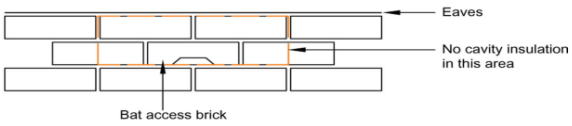
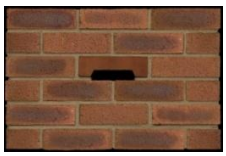
Access tiles or bricks	In situ	Description	Company	Estimated price
		**Tudor Bat access tile set**	**Tudor Clay Roof Tiles**	
		Ventilation tiles that can be adapted for bat access	Aspect Roofing	
		**Bat access brick**	Tamworth Property Services t) 01827 310475 chris@bat-survey.co.uk	
		**Ibstock bat roost entrance arch brick**	**Ibstock**	
		**Bat access slate**	JD Products **Owens Slate Service** Summit Slate	**£40-80**
		**Habibat Roof Access Tile**	Dreadnought Tiles Habibat	

Positioning considerations:

Aspect

Temperature is known to be the major factor influencing successful uptake of artificial roost by bats. In general, bats seek warm spaces to help them with rearing young. For this reason, bat boxes should be located where they will receive the maximum amount of sunlight. In the northern hemisphere this will be the southerly aspects/orientation (south, south-west and south-east). However, it is helpful to install bat boxes in more than one aspect to allow a choice of roosting conditions. Bat boxes located on a shady side will remain cooler and will be more suitable for use during the hibernation period (winter) or by male bats all year round.

Height

Position the bat boxes a minimum of 2 meters above ground. Avoid placement above windows, doors and wall climbing plants, thereby reducing the likelihood of predation by cats. A position near the eaves or gable apex of the property would be preferable.

Other considerations

To make the bat box a potential roost for a wider range of bat species, it is helpful to consider whether there is nearby linear vegetation features such as hedges. This is because some bat species use these features for navigation between their roosting site and feeding ground and to avoid flying in open and exposed areas.

Resources:

- Williams, C. 2010. *Biodiversity for low and zero carbon buildings: a technical guide for new build.* RIBA Publishing, UK
- Bat Conservation Trust, 2010. *Bats in Buildings*. Bats and the Built Environment Series: Volume 1. http://www.bats.org.uk/publications_download.php/247/Bats_and_Buildings_finalDec2010.pdf
- BCT webpages: http://www.bats.org.uk/pages/bats_and_buildings.html

Version 5: updated June 2012

Bat Conservation Trust 

BATS AND LIGHTING IN THE UK
Bats and the Built Environment Series

This document is aimed at lighting engineers, lighting designers, planning officers, developers, bat workers and anyone specifying lighting. It is intended to raise awareness of the impacts of lighting on bats and mitigation is suggested for various scenarios. It also offers an explanation of the facts associated with the lighting industry for the benefit of bat workers.

This is a working document and as such the information contained will be updated in line with advances in our knowledge both into the impact on bats and also to reflect the advances in technology available in the lighting industry.

ABOUT BATS – FOR THE LIGHTING INDUSTRY

General Ecology

Bats are the only true flying mammals. Like us, they are warm-blooded, give birth and suckle their young. They are also long-lived, intelligent and have a complex social life. In Britain there are 17 species, all of which are small (most weigh less than a £1 coin) and eat insects.

Bats have evolved a number of unusual features, mainly connected with their ability to fly. Their wings are formed from a web of highly elastic skin stretched over greatly elongated finger bones, the legs and tail, though their thumbs remain free to help them cling on when roosting. Bats have also developed a highly sophisticated echolocation system that allows them to avoid obstacles and catch tiny insects, which they seize in flight or pick off water, the ground or foliage, even in complete darkness. When they're flying, bats produce a stream of high-pitched calls and listen to the echoes to produce a sound picture of their surroundings.

Some bats specialise in catching large insects such as beetles or moths but others eat large numbers of very small insects, such as gnats, midges and mosquitoes. Bats gather to feed wherever there are lots of insects, so the best places for them include traditional pasture, woodland, marshes, ponds and slow moving rivers.

During the winter there are relatively few insects available, so bats hibernate. In September and October they put on weight and then, as the weather gets colder, they seek out appropriate sheltered roosts, let their body temperature drop to close to that of their surroundings and slow their heart rate to only a few beats per minute. This greatly reduces their energy requirements so that their food reserves last as long as possible. Bats don't hibernate right through the winter but may wake up and go out to feed on mild evenings when insects are active.

During the spring and summer period female bats gather together into maternity colonies for a few weeks to give birth and rear their young (called pups). Usually only one pup is born each year. This is looked after carefully and suckled for between four and six weeks until it is old enough to fly out and hunt for itself. Bats don’t build nests and don't bring food back to the roost to feed their young, so the baby lives only on its mother's milk until it is old enough to fly. Once the baby is independent, the colony breaks up and the bats generally move to other roosts. Bats may gather together from a large area to form these maternity roosts, so any disaster at the summer breeding site can affect the whole colony of bats from a wide surrounding area. Many of these maternity sites are used every summer as bats have a strong tradition of returning to the same site year after year.

Legal Protection of bats

Due to the decline in bat numbers, all species of bat are protected by the Wildlife & Countryside Act (1981) (as amended) and the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended). This makes it illegal to: kill, injure, capture or disturb bats, obstruct access to bat roosts or damage/destroy bat roosts. Lighting in the vicinity of a bat roost causing disturbance could constitute an offence, so it is important that Natural England, Countryside Council for Wales, Scottish Natural Heritage or Environment and Heritage Service, Northern Ireland is consulted and allowed time to provide advice on lighting proposals in the vicinity of bats and roosts.

Impacts on bats

Roosts

Illuminating a bat roost creates disturbance and may cause the bats to desert the roost. Light falling on a roost access point will at least delay bats from emerging and this shortens the amount of time available to them for foraging. As the main peak of nocturnal insect abundance occurs at and soon after dusk, a delay in emergence means this vital time for feeding is missed.

Insects and foraging

In addition to causing disturbance to bats at the roost, artificial lighting can also affect the feeding behaviour of bats. There are two aspects to this. One is the attraction that light from certain types of lamps has to a range of insects; the other is the presence of lit conditions.

Many night flying species of insect are attracted to light, especially those lamps that emit an ultra-violet component and particularly if it is a single light source in a dark area. As well as moths a range of other insects can be attracted to light such as craneflies, midges and lacewings. Studies have shown that, although noctules, Leisler's, serotine and pipistrelle bats swarm around white mercury street lights (this would also apply to metal halide) feeding on the insects attracted to the light, this behaviour is not true for all bat species. The slower flying broad winged species such as long-eared bats, *Myotis* species (which include Brandt's, whiskered, Daubenton's, Natterer's and Bechstein's), Barbastelle and greater and lesser horseshoe bats generally avoid street lights. In addition it is also thought that insects are attracted to lit areas from further afield. This is thought to result in adjacent habitats supporting reduced numbers of insects. This is a further impact on the ability of the light avoiding bats to be able to feed. It is noticeable that most of Britain's rarest bats are among those species listed as avoiding light. Clearly, effective mitigation where there is potential for impact on bats has importance in the conservation of these species.

Artificial lighting is thought to increase the chances of bats being preyed upon. Many avian predators will hunt bats which may be one reason why bats avoid flying in the day. Observations have been made of kestrels (diurnal raptors) hunting at night under the artificial light along motorways.

Lighting can be particularly harmful if used along river corridors, near woodland edges and near hedgerows used by bats. In mainland Europe, in areas where there are foraging or 'commuting' bats, stretches of road are left unlit or lighting is designed in such a way as to avoid isolation of bat colonies.

Other behaviours
Artificial lighting disrupts the normal 24-hour pattern of light and dark which is likely to affect the natural behaviour of bats. Bright light may reduce social flight activity and cause bats to move away from the light area. Studies have shown that continuous lighting along roads creates barriers which some bat species cannot cross. For example, Daubenton's bats move their flight paths to avoid street lamps. The following images indicate possible scenarios where bats' commuting routes may cross a road. They are linear features such as tree lines, river corridors, hedgerows or where tree canopies form a link over the road.

ABOUT THE LIGHTING – FOR BAT WORKERS

Types of lights in use
A range of lighting equipment is available:

1) **Low pressure sodium lamps (SOX)** (typical orange lamps seen along roadsides). Light is emitted at one wavelength, contains no ultraviolet (UV) light and has a low attraction to insects. The lamps tend to be large which makes it more difficult to focus the light from these lamps. These are in the gradual process of being removed or replaced.
2) **High pressure sodium lamps (SON) (**brighter pinkish-yellow lamps). Commonly used as road lighting. Light is emitted over a moderate band of long wavelengths including a small UV component. Insects are attracted to the brighter light. The lamp is of medium size and the light can be more easily directed than low pressure sodium. This is the predominant lamp now in use.
3) **Mercury lamps (MBF)** (bluish-white lamps). These emit light over a moderate spectrum including a larger component of UV light to which insects are particularly sensitive. Insects are attracted in large numbers along with high densities of bat species. (Rydell & Racey 1993). They are rare now and are not used in new developments.
4) **White SON.** This is whiter than High Pressure Sodium and has a larger component of UV light.
5) **Metal Halide**. A small lamp and therefore more easy to focus light and make directional. Emits less UV light than mercury but more than high pressure sodium. It comes in three forms a) Quartz arc tube (HQI); b) Ceramic arc tube (CDM-T) and c) Cosmo which is a new ceramic form.

6) **Light Emitting Diodes** (LEDs). Predicted to compete with metal halide and high pressure sodium as a widely used light source within the next few years. The light emitted is more directional. The light is produced in a narrow beam. It is instant light.
7) **Tungsten Halogen** (more directional). It is not used in new lighting schemes but may be encountered as security light on a private household.
8) **Compact Fluorescent** Mostly in use in residential street lighting. It produces a white light that does include UV light. It can be used at a low wattage and therefore on a low output to achieve low lux.

Legal requirements for lighting

There is no legislation requiring an area or road to be lit.
The Building Regulations specify that 150 W is the maximum for exterior lighting of buildings but this does not apply to private individuals.
There are a number of British Standards that relate to various components of lighting and there are also guidelines that relate to crime prevention, prevention of vehicular accidents and amenity use.
Many County councils and less often District and Borough councils set out standards in local guidance policy documents. These are sometimes based on the advice given by the Highways Authority 'TA49 – Approval of new and replacement lighting on trunk roads and trunk road motorways'.
In assessing the need for lighting it would be beneficial to ask the local authority for their lighting policy document as this should incorporate all of the above.

The installation of lighting and the planning system

Domestic lighting needs no planning permission and depends on direct advice being given to the householder. Lighting associated with new development or a listed building does require planning permission. Planning officers or developers when dealing with applications for lighting in an area of suitable bat habitat eg. woodland, old pasture, linking hedgerows and water habitats) should seek information on bat roosts in the area.

If assistance is needed they can contact the BCT Bat Helpline 0845 1300 228 who may be able to suggest how best to access information on bat roosts known in the area. If bat roosts are suspected, it may be necessary to conduct a bat survey. A survey may need to

determine the species of bat affected, their population levels, the likely impact of the lighting on the bats and possible mitigation.
The need to install lighting should be questioned. Where lighting is permitted, as may be necessary for public safety, conditions should be imposed to ensure the impact of the lighting on the bats is kept to a minimum. The use of a lighting design computer program that predicts where light will fall should be used to predict the potential impact and to plan mitigation.
The consultation on the addition to PPS23 on Pollution Control of Annex 3 on lighting is on hold at the present time (July 2007) until the outcome of the Baker review is known.

MITIGATION OF LIGHTING IMPACTS ON BATS

1. BAT ROOSTS

No bat roost (including access points) should be directly illuminated. If it is considered necessary to illuminate a building known to be used by roosting bats, the lights should be positioned to avoid the sensitive areas. Close offset accent lighting causes less light pollution; it is more specific and can be designed to avoid bat sensitive areas, and better highlights the features of the subject of the illumination.

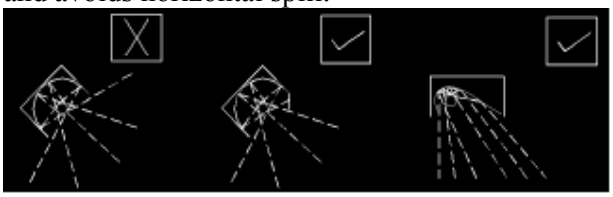
2. FORAGING AND COMMUTING

Type of lamp (light source)
The impact on bats can be minimised by the use of low pressure sodium lamps or high pressure sodium instead of mercury or metal halide lamps where glass glazing is preferred due to its uv filtration characteristics.
Luminaire and light spill accessories
Lighting should be directed to where it is needed and light spillage avoided. This can be achieved by the design of the luminaire and by using accessories such as hoods, cowls, louvres and shields to direct the light to the intended area only. Planting can also be used as a barrier or manmade features that are required within the build can be positioned so as to form a barrier.
Lighting column
The height of lighting columns in general should be as short as is possible as light at a low level reduces the ecological impact. However, there are cases where a taller column will enable light to be directed downwards at a more acute angle and thereby reduce horizontal spill. For pedestrian lighting this can take the form of low level lighting that is as directional as possible and below 3 lux at ground level. The acceptable level of lighting may vary dependent upon the surroundings and on the species of bat affected.
Predicting where the light cone and light spill will occur
There are lighting design computer programs that are widely in use which produce an image of the site in question, showing how the area will be affected by light spill when all the factors of the lighting components listed above are taken into consideration. This should be a useful tool to inform the mitigation process.

Light levels
The light should be as low as guidelines permit. If lighting is not needed, don't light.
Timing of lighting
The times during which the lighting is on should be limited to provide some dark periods. Roads or trackways in areas important for foraging bats should contain stretches left unlit to avoid isolation of bat colonies. These unlit stretches should be 10 metres in length either side of commuting route.

3. FLOODLIGHTING OF SPORTS OR EVENTS

The use of asymmetric beam floodlights (as opposed to symmetric) orientated so that the glass is parallel to the ground will ensure that the light is cast in a downward direction and avoids horizontal spill.



See the National Trust guide to 'Events, concerts and bats' at http://www.nationaltrust.org.uk/main/w-bat05_events.pdf for further advice on ways to reduce the impact of event lighting.

4. SECURITY LIGHTING

Power It is rarely necessary to use a lamp of greater than 2000 lumens (150 W) in security lights. The use of a higher power is not as effective for the intended function and will be more disturbing for bats.
Movement sensors Many security lights are fitted with movement sensors which, if well installed and aimed, will reduce the amount of time a light is on each night. This is more easily achieved in a system where the light unit and the movement sensor are able to be separately aimed.
Timers If the light is fitted with a timer this should be adjusted to the minimum to reduce the amount of 'lit time'.
Aim of light The light should be aimed to illuminate only the immediate area required by using as sharp a downward angle as possible. This lit area must avoid being directed at, or close to, any bats' roost access points or flight paths from the roost. A shield or hood can be used to control or restrict the area to be lit. Avoid illuminating at a wider angle as this will be more disturbing to foraging and commuting bats as well as people and other wildlife.
Alternatives
It may be a better solution for security lighting on domestic properties to use a porch light.

Ongoing areas of research

- The impact of light on commuting corridors used by lesser horseshoe bats. Emma Stone, University of Bristol
- The effects of lighting on prime bat foraging areas within London, concentrating on riparian habitats and open spaces. Alison Fure.
- The effect of light and noise on British bat species. Frank Greenaway.

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Glossary of terms
(used in this article or that may be used by the lighting industry)

Arc tube	A tube normally ceramic or quartz enclosed by the outer glass envelope of a HID lamp that contains the arc stream.
Asymmetric beams	Lamp is off-centre in a reflector more steeply curved at one end.
Candela	The intensity of a light source in a specific direction. Unit of Luminous intensity
Contrast	The relationship between the luminance of an object and its background. The higher the contrast the more likely it is an object

	can be seen.
Cowl	Physical light spill control accessory.
Diffuse	Term describing dispersed light distribution referring to the scattering of light.
Efficacy	A measure of light output against energy consumption measured in lumens per watt.
HID	High Intensity Discharge. Describes mercury vapour, metal halide and high pressure sodium lamps.
High Pressure Sodium Lamp	A HID lamp whose light is produced by radiation from high pressure sodium vapour which usually includes a small amount of UV light.
Hood	Physical light spill control accessory.
Illuminance	Illuminance is the quantity of light, or luminous flux, falling on a unit area of a surface. It is designated by the symbol E. The unit is the lux (lx).
Lamp	Light source.
Light cone	The angle at which the beam falls off to 50% of peak intensity.
Light Pollution	The spillage of light into areas where it is not required. Also known as obtrusive light.
Light spill	The light that falls outside the light cone.
Light Trespass (nuisance)	Light that impacts on a surface outside of the area designed to be lit by a lighting installation. The correct legal term is nuisance.
Louvres	Physical light spill control accessory.
Low Pressure Sodium	A discharge lamp in which light is produced by radiation from low pressure sodium vapour. Emits light at only 589nm ie. monochromatic.
Lumen	The unit of light output from a lamp.
Luminaire	Light fitting or unit designed to distribute light from a lamp or lamps.
Luminance	The physical measure of the stimulus that produces the sensation of brightness measured by the luminous intensity reflected in a given direction. The unit is the candela per square metre (cd/m^2).
Lux (LX)	Illuminance is the quantity of light or luminous flux, falling on a unit area of a

	surface in the environment. It is designated by the symbol E. The unit is lux (lx).
Metal Halide (includes CDM-T)	A type of HID lamp in which most of the light us produced by radiation of metal halide and mercury vapours in the arc tube. Emits UV light. UV poor variants are available. It comes in three forms a) Quartz arc tube (HQI); b) Ceramic arc tube (CDM-T) and c) Cosmo which is a new ceramic form
Mercury	High pressure white light lamp that emits significant UV light.
Optic	The components of a luminaire such as reflectors, refractors, protectors which make up the directional light control section.
Photocell	A unit which senses light to control luminaires.
Reflector	A device used to reflect light in a given direction.
Refractor	A device used to redirect the light output from a lamp when the light passes through it. It is usually made from prismatic glass or plastic.
Shield	Physical light spill control accessory.
Sky glow	The brightening of the night sky caused by artificial lighting.
Symmetric beams	Lamp mounted in the centre of the reflector.
Ultra violet (UV)	Radiation that is shorter in wavelength and higher in frequency than visible violet light.
Voltage	The difference in electrical potential between two points of an electrical circuit.
Watt (W)	The unit for measuring electrical power.